

# REPORT DOCUMENTATION PAGE

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MEMORANDUM FOR PRS (In-House/Contractor Publication)

FROM: PROI (TI) (STINFO)

10 October 2000

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2000-191**  
Liu, C.T., "Monitoring Initiation and Growth of Crack in a Particulate Composite Material Using  
Nondestructive Testing Techniques"

**2001 SEM Conference on Experimental and Applied Mechanics**  
**(Portland, OR 4-6 Jun 2001) (Deadline: 13 Oct 2000)**

**(Statement A)**

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.

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Signature \_\_\_\_\_ Date \_\_\_\_\_

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PHILIP A. KESSEL  
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Monitoring Initiation and Growth of Crack in a Particulate Composite Material Using  
Nondestructive Testing techniques

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An important engineering problem in structural design is evaluating structural integrity and reliability. It is well known that structural strength may be degraded during its design life due to mechanical or chemical aging, or a combination of these two aging mechanisms. Depending on the structural design, material type, service loading, and environmental condition, the cause and degree of strength degradation due to the different aging mechanisms differs. One of the common causes of strength degradation is the result of crack development in the structure.

In recent years, a considerable amount of work has been done in studying damage characteristics in highly filled polymeric materials, using nondestructive testing techniques. The importance of these studies stems from the fact that damage can significantly affect the constitutive and the crack growth behavior in these materials. Experimental findings reveal that damage, expressed in terms of the attenuation of the acoustic energy, increases with increasing strain rate, and the critical damage is relatively insensitive to the strain rate. They also reveal that the damage state correlates well with the constitutive behavior of the material. In addition, for pre-cracked specimens, the damage state near the tip of a stationary crack is highly dependent on the loading history.

In this study, Lockheed-Martin Research Laboratory's high-energy real-time x-ray system (HERTS) was used to monitor the processes of initiation and growth of damage and crack in edge-cracked sheet specimens. The specimens were made of a particulate composite material containing hard particles embedded in a rubber matrix and tested at a constant strain rate of  $1.0 \text{ min}^{-1}$ . The experimental data were analyzed and the results were discussed.